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BHAVAN'S VIVEKANANDA COLLEGE
OF SCIENCE, HUMANITIES & COMMERCE
Sainikpuri, Secunderabad – 500094
(Reaccredited with 'A' grade by NAAC)
Autonomous College - Affiliated to Osmania University

Department of Biochemistry & Nutrition

Template for B. Sc BIOCHEMISTRY under CBCS
PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)
Academic year 2024-25
Batch 2022-23 to 2024-25

FIRST YEAR – SEMESTER-I				
Course Code	**Course title**	**Course Type**	**HPW**	**CREDITS**
	Environmental Science/Computer Skills	AECC-1	2	2
	English	CC-1A	4	4
	Second Language	CC-2A	4	4
BC134/ BC134 P	**Chemistry of Biomolecules**	**DSC-1A**	**4T+2P=6**	**4+1=5**
	Optional 2	DSC-2A	4T+2P=6	4+1=5
	Optional 3	DSC-3A	4T+2P=6	4+1=5
	TOTAL		**28**	**25**
SEMESTER-II				
	Environmental Science/Computer Skills	AECC-2	2	2
	English	CC-1B	4	4
	Second Language	CC-2B	4	4
BC234/ BC234 P	**Chemistry of Proteins, Nucleic acids and Bioenergetics**	**DSC-1B**	**4T+2P=6**	**4+1=5**
	Optional 2	DSC-2B	4T+2P=6	4+1=5
	Optional 3	DSC-3B	4T+2P=6	4+1=5
	TOTAL		**28**	**25**
SECOND YEAR –SEMESTER-III				
	English	CC-1C	3	3
	Second Language	CC-2C	3	3
BC334/ BC334 P	**Enzymology and Metabolism of Carbohydrates and Lipids**	**DSC-1C**	**4T+2P=6**	**4+1=5**
	Optional 2	DSC-2C	4T+2P=6	4+1=5
	Optional 3	DSC-3C	4T+2P=6	4+1=5
	Communicative Skills	**SEC 1**	**2**	**2**
SE334	**Basics in Biochemical calculations and Biostatistics**	**SEC 2**	**2**	**2**
	TOTAL		**28**	**25**

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SEMESTER-IV				
	English	CC-1D	3	3
	Second Language	CC-2D	3	3
BC434/ BC434 P	**Biochemical techniques and Metabolism of Amino acids and Nucleotides**	**DSC-1D**	**4T+2P=6**	**4+1=5**
	Optional 2	DSC-2D	4T+2P=6	4+1=5
	Optional 3	DSC-3D	4T+2P=6	4+1=5
	Universal Human Values	**SEC-3**	**2**	**2**
SE434	**Clinical Laboratory Diagnostics**	**SEC-4**	**2**	**2**
	TOTAL		**28**	**25**
THIRD YEAR –SEMESTER-V				
	English	CC-1E	3	3
	Second Language	CC-2E	3	3
BC534/ BC534 P	**A. Physiology and Clinical Biochemistry**	**DSE-1E**	**4T+2P=6**	**4+1=5**
	(or)			
BC534A/ BC534A P	**B. Microbiology, Genetics and rDNA technology**			
	Optional 2	DSE-2E	4T+2P=6	4+1=5
	Optional 3	DSE-3E	4T+2P=6	4+1=5
GE534	**Biochemistry and Physiology**	**GE**	**4T**	**4**
	TOTAL		**28**	**25**
SEMESTER-VI				
	English	CC-1F	3	3
	Second Language	CC-2F	3	3
BC634/ BC634 P	**A. Molecular Biology and Immunology**	**DSE-1F**	**4T+2P=6**	**4+1=5**
	(or)			
BC634A/ BC634A P	**B. Cell Biology and Biotechnology**			
	Optional 2	DSE-2F	4T+2P=6	4+1=5
	Optional 3	DSE-3F	4T+2P=6	4+1=5
BC634_O BC634_PW	**Optional Paper Theory – Biochemistry in health and Disease / Project Work**		**4**	**4**
	TOTAL		**28**	**25**
	TOTAL CREDITS			**150**

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PROGRAM NAME: B. Sc. (MICROBIOLOGY, BIOCHEMISTRY, CHEMISTRY- MBBCC)
(w.e.f 2022-23)

COURSE NAME: CHEMISTRY OF BIOMOLECULES

PAPER CODE: BC134 **PPW:4**
YEAR/SEMESTER: I/I **NO. OF CREDITS: 4**

COURSE OBJECTIVE: To familiarize the students with the basic classification and identification of different biomolecules.

UNIT-WISE COURSE OBJECTIVES:

COb1 To explain the molecular architecture of prokaryotic and eukaryotic cells.
COb2 To discuss classification of amino acids and properties of proteins.
COb3 To discuss the classification of sugars and their chemical reactions.
COb4 To explain the classification of fats.

UNIT I: - Introduction to molecules of life	**15 hrs**
Origin of life- chemical evolution and rise of living systems.	2hrs
Water as a biological solvent and its role in biological processes.	1hr
pH, Buffers, Henderson- Hasselbalch equation.	2hrs
Acid-base and electrolyte balance in the body.	2hrs
Structure and classification of prokaryotes.	2hrs
Metabolic energy sources employed by prokaryotes.	1hr
Structure and function of eukaryotic cell (plant and animal cell).	2hrs
Phylogenetic classification and differentiation of eukaryotic cell.	2hrs
Biological structures and metabolic processes in cell.	1hr

UNIT II: - Amino acids and peptides	**15 hrs**
Amino acids: Classification, structure, stereochemistry.	3hrs
Chemical reactions of amino acids due to carboxyl and amino groups.	3hrs
Titration curve of glycine and p*Ka* values.	2hrs
Essential and non-essential amino acids.	1hr
Unusual amino acids.	1hr
Peptide bond – nature, Types of conformations.	3hrs
Biologically active peptides and polypeptides.	2hrs

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UNIT III: - Carbohydrates **15hrs**

Classification, monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation. 4hrs

Reactions of carbohydrates (due to functional groups-hydroxyl, aldehyde and ketone) 2hrs

Amino sugars, Glycosides. 1hr

Structure and biological importance of disaccharides (sucrose, lactose, maltose, isomaltose, trehalose), trisaccharide's (raffinose, melezitose), structural polysaccharides (cellulose, chitin, pectin) and storage polysaccharides (starch, inulin, glycogen). 4hrs

Glycosaminoglycans, Bacterial cell wall polysaccharides. 2hrs

Outlines of glycoproteins, glycolipids and blood group substances. 2hrs

UNIT IV: - Lipids **15hrs**

Lipids: Classification, saturated and unsaturated fatty acids. 2hrs

Structure and properties of fats and oils. 1hr

Acid value, saponification and iodine values, rancidity. 2hrs

General properties and structures of phospholipids and sphingolipids. 2hrs

Cholesterol- structure and properties. 1hr

Lipoproteins: Types and functions. 2hrs

Properties of lipid aggregates – micelles, bilayers. Liposomes 2hrs

Composition and architecture of membranes. 1hr

Fundamental properties of biological membranes. 1hr

Experimental proof for fluidity and dynamic properties. 1hr

REFERENCES:

1.Lehninger, Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.

2. Biochemistry, 4th Edition- Donald Voet, Judith G. Voet. - Publisher John Wiley & Sons.

3. Outlines of Biochemistry- Conn. E. E., Stumpf. P.K., Bruening, G and Doi. R.H., John Wiley & Sons.

4. Biochemistry- Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Ltd.

5. Textbook of Biochemistry – West. E.S., Todd. W. R, Mason. H.S., and Bruggen, J.T.V., Oxford & IBH.

COURSE OUTCOMES:

At the end of the course students will be able to:

BC134.CO1 Compare the organization of prokaryotic cell to eukaryotic cell.

BC134.CO2 Differentiate the amino acids based on their side chains.

BC134.CO3 Distinguish between the simple and complex sugars.

BC134.CO4 Relate the different types of fats and their importance in cellular architecture.

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PROGRAM NAME: B. Sc. (MICROBIOLOGY, BIOCHEMISTRY, CHEMISTRY-MBBCC)
(w.e.f 2022-23)

COURSE NAME: QUALITATIVE ANALYSIS OF BIOMOLECULES

PAPER CODE: BC134 P **PPW: 3**
YEAR/SEMESTER: I/I **NO. OF CREDITS: 1**

COURSE OBJECTIVES:

COb1 To inculcate good laboratory practices and laboratory hygiene.

COb2 To learn preparation of standard solutions and buffers and identify the biomolecules qualitatively.

1. Introduction to Good Laboratory Practices (GLP).

2. Principles of Laboratory Hygiene and Safety.

3. Preparation of standard solutions. Molarity, Normality, percentage solutions.

4. Preparation of buffers (acidic, neutral and alkaline) and determination of pH. Calibration of pH meter.

5. Titration curve of glycine and determination of *p*K and *p*I values.

6. Qualitative identification of carbohydrates - glucose, fructose, ribose/xylose, maltose, sucrose, lactose, starch/glycogen.

7. Preparation of Osazones and their identification.

8. Qualitative identification of amino acids - histidine, tyrosine, tryptophan, cysteine, arginine.

9. Qualitative identification of lipids - solubility, saponification, acrolein test, Salkowski test.

10. Test for unsaturation – Hubl's iodine test, Bromine decolourisation test.

REFERENCES:

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern

COURSE OUTCOMES:

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At the end of the course students will be able to:

BC134P.CO1 Gain knowledge in understanding laboratory safety and implementing routine practice.

BC134P.CO2 Prepare various buffers and solutions and perform qualitative tests to identify biomolecules in different sources.

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PROGRAM NAME: B. Sc. (MICROBIOLOGY, BIOCHEMISTRY, CHEMISTRY-MBBCC)
(w.e.f 2022-23)

COURSE NAME: CHEMISTRY OF PROTEINS, NUCLEIC ACIDS AND BIOENERGETICS

PAPER CODE: BC234 **PPW:4**
YEAR/SEMESTER: I/II **NO OF CREDITS:4**

COURSE OBJECTIVE: To familiarize the students with the structural features of proteins, nucleic acids and basic concepts of Bioenergetics.

UNIT-WISE COURSE OBJECTIVES:

COb1 To understand the structural hierarchy of proteins.
COb2 To discuss the structure and properties of nucleic acids.
COb3 To explain the energy transformation reactions in biological systems.
COb4 To describe the organization of ETC complexes.

UNIT I: - Proteins	**15hrs**
Proteins classification based on solubility, shape and functions.	3hrs
Determination of amino acid composition of proteins.	2hrs
General properties of proteins.	2hrs
Denaturation and renaturation of proteins.	1hr
Structural organization of proteins- primary structure, secondary structure, tertiary and quaternary structures (eg, hemoglobin and myoglobin).	4hrs
Forces stabilizing the structure of proteins.	1hr
Strategies of protein sequencing.	2hrs

UNIT II: - Nucleic Acids	**15hrs**
Nature of nucleic acids, Structure of purines, pyrimidines, nucleosides, nucleotides.	3hrs
Stability and formation of phosphodiester linkages.	1hr
Effect of acids, alkali and nucleases on DNA and RNA.	1hr
Experiments showing DNA as store of genetic information.	2hrs
Structure of Nucleic acids - Watson-Crick DNA double helix structure.	1hr
Types of DNA/RNA.	2hrs
Structural variations of DNA/RNA - Palindromes, mirror repeats, hairpin and cruciform.	1hr
Introduction to circular DNA, super coiling.	1hr

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Helix to random coil transition. Denaturation and renaturation of nucleic acids.
Hyperchromic effect, Tm values and their significance. 1hr
Re-association kinetics, cot curves and their significance. 1hr
Additional functions of nucleotides – energy carriers, as components of enzyme cofactors 1hr

UNIT III: - Bioenergetics -I **15 hrs**

Energy transformations in the living system. 1hr
Enthalpy, entropy and Gibb's free energy. 2hrs
Reduction potentials. 2hrs
Free energy concept. Exergonic and endergonic reactions. 2hrs
High energy compounds. 2hrs
Role of ATP in biological systems. 1hr
Inorganic phosphate- phosphate group donor. 1hr
Phosphate group transfer potential. Substrate level phosphorylation. 2hrs
Cytochromes-structure, types and their functions. 2hrs

UNIT IV: - Bioenergetics- II **15hrs**

Biological oxidations: Definition, enzymes involved- oxidases, dehydrogenases and oxygenases.
Redox reactions. 3hrs
Ultra-structure of mitochondria. Electron transport chain and carriers involved. 3hrs
Coenzymes and proteins as electron carriers. 2hrs
Oxidative phosphorylation, theories of oxidative phosphorylation- Mitchell's chemiosmotic theory,
F_o F_1- ATPase. 3hrs
Inhibitors of respiratory chain and oxidative phosphorylation, Uncouplers. 2hrs
Formation of reactive oxygen species and their disposal through enzymatic reactions. 2hrs

REFERENCES:

1. Lehninger, Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W.H. Freeman
2. Biochemistry, 4th Edition- Donald Voet, Judith G. Voet. - Publisher John Wiley & Sons.
3. Biochemistry- Satyanarayana U and Chakrapani. U, Books & Allied Pvt. Ltd.

COURSE OUTCOMES:

At the end of the course students will be able to:

BC234.CO1 Relate to the structural organization of proteins to their functions.
BC234.CO2 Distinguish the structural features and properties of nucleic acids.
BC234.CO3 Interpret the concepts of biological oxidation and energy production.
BC234.CO4 Demonstrate the organization of ETC complexes.

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PROGRAM NAME: B. Sc. (MICROBIOLOGY, BIOCHEMISTRY, CHEMISTRY-MBBCC)
(w.e.f 2022-23)

COURSE NAME: BIOCHEMICAL PREPARATIONS

PAPER CODE: BC234 P **PPW: 3**
YEAR/SEMESTER: I/II **NO. OF CREDITS: 1**

COURSE OBJECTIVES:

COb1 To understand the concept of absorption maxima of coloured and colourless solutions.
COb2 To isolate and identify macromolecules from natural sources.

1. Absorption maxima of colored substances- *p*-Nitrophenol, Methyl orange and $KMnO_4$
2. Absorption spectra of protein-BSA, nucleic acids- Calf thymus DNA.
3. Isolation and identification of cholesterol from egg yolk.
4. Isolation of lipids from biological samples.
5. Isolation and identification of starch from potato.
6. Isolation and identification of albumin from egg white.
7. Isolation and identification of casein from milk.
8. Isolation and identification of glycogen from liver.
9. Quantitation of glycine by formol titration method.

REFERENCES:

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern

COURSE OUTCOMES:

At the end of the course students will be able to:

BC234P.CO1 Analyse the presence of compounds based on its absorption maxima.
BC234P.CO2 Apply different isolation methods for various biomolecules from their natural sources.

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PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)
(Academic year2023-24)

COURSE NAME: BIOCHEMICAL PREPARATIONS

PAPER CODE: BC234P **PPW: 3**
YEAR/SEMESTER: I/II **NO. OF CREDITS: 1**

COURSE OBJECTIVES:

COb1 To understand the concept of absorption maxima of coloured and colourless solutions.
COb2 To isolate and identify macromolecules from natural sources.

1. Absorption maxima of colored substances- p-Nitrophenol, Methyl orange and $KMnO_4$.
2. Absorption spectra of protein-BSA, nucleic acids- Calf thymus DNA.
3. Isolation and identification of cholesterol from egg yolk.
4. Isolation of lipids from biological samples.
5. Isolation and identification of lecithin from egg yolk.
6. Isolation and identification of starch from potato.
7. Isolation and identification of albumin from egg white.
8. Isolation and identification of casein from milk.
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2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern

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At the end of the course students will be able to:

BC234P.CO1 Analyse the presence of compounds based on its absorption maxima.
BC234P.CO2 Apply different isolation methods for various biomolecules from their natural sources.

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(Academic year 2023-24)

PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: ENZYMOLOGY AND METABOLISM OF CARBOHYDRATES AND LIPIDS

PAPER CODE: BC334 **PPW: 4**
YEAR/SEMESTER: II/III **NO.OF CREDITS: 4**

COURSE OBJECTIVE: To familiarize students with nature, kinetics and different regulatory mechanisms of enzymes and to describe the metabolism and regulation of carbohydrates and lipids.

UNIT-WISE COURSE OBJECTIVES:

CObl To discuss the nature of enzymes, factors affecting enzyme activity and basics of enzyme kinetics.
COb2 To outline the concept of enzyme catalysis and regulation with examples.
COb3 To describe about carbohydrate metabolism in plants and animals.
COb4 To explain the significance of lipid metabolism.

Unit I: - Enzymes	**15 hrs**
Introduction to biocatalysis, differences between chemical and biological catalysis.	1hr
Nomenclature and classification of enzymes.	2hrs
Enzyme specificity. Active site.	1hr
Principles of energy of activation, transition state.	2hrs
Definition of holo-enzyme, apo-enzyme, coenzyme, cofactor.	1hr
Fundamentals of enzyme assay, enzyme units.	1hr
Factors affecting the catalysis - substrate concentration, *p*H, temperature.	2hrs
Michaelis-Menten equation for uni-substrate reaction (derivation not necessary), Lineweaver- Burke plot, Significance of K_m and V_{max}.	2hrs
Enzyme inhibition- irreversible and reversible, types of reversible inhibitions - competitive, non-competitive and uncompetitive.	3hrs

Unit-II: - Enzyme Catalysis	**15 hrs**
Mechanism of enzyme action with examples - acid-base catalysis, covalent catalysis, electrostatic catalysis, and metal ion catalysis.	4hrs
Regulation of enzyme activity- allosterism and co-operativity, Glutamine synthetase as an allosteric enzyme.	3hrs
Covalent modulation - covalent phosphorylation of phosphorylase.	1hr
Zymogen activation- activation of trypsinogen and chymotrypsinogen.	1hr
Isoenzymes (CK, LDH) and Ribozyme.	2hrs
Multi enzyme complexes (PDH).	1hr

Immobilized enzymes.	2hrs
Catalytic antibodies.	1hr

Unit III: - Carbohydrate Metabolism	**15 hrs**
Concept of anabolism and catabolism.	1hr
Glycolytic pathway, energy yield, Fate of pyruvate - formation of lactate and ethanol, Pasteur effect.	3hrs
Citric acid cycle, regulation, energy yield, amphipathic role.	2hrs
Anaplerotic reactions.	1hr
Glycogenolysis and glycogenesis.	2hrs
Pentose phosphate pathway.	2hrs
Gluconeogenesis.	1hr
Photosynthesis - Light and Dark reactions, Calvin cycle, C4 Pathway.	3hrs

Unit IV: - Lipid Metabolism	**15 hrs**
Catabolism of fatty acids (β- oxidation) with even numbers.	2hrs
Catabolism of fatty acids with odd number of carbon atoms.	1hr
Ketogenesis.	1hr
de novo synthesis of fatty acids, elongation of fatty acids in mitochondria and microsomes	3hrs
Biosynthesis and degradation of triacylglycerol.	2hrs
Biosynthesis and degradation of lecithin.	1hr
Biosynthesis and regulation of cholesterol metabolism.	2hrs
Role of HDL, LDL, and Very-low-density lipoprotein (VLDL) and cholesterol levels in body.	3hrs

REFERENCES:

1. Lehninger, Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W.H. Freeman.
2. Biochemistry- Satyanarayana, U and Chakrapani, U, Books & Allied Pvt. Ltd.
3. Principles of Biochemistry: General Aspects- Smith, E. L., Hill, R.L. Lehman, I.R. Lefkowitz, R. J. Handler, P., and White, A. McGraw- Hill.

COURSE OUTCOMES:

At the end of the course students will be able to:

BC334.CO1 Interpret the significance and role of enzymes in a living cell.
BC334.CO2 Correlate the function of enzymes with cellular homeostasis.
BC334.CO3 Relate the metabolic events of carbohydrates in conversion of food to energy to run cellular processes.
BC334.CO4 Illustrate the pathways of lipid metabolism and their significance in energy production.

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PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: QUANTITATIVE ANALYSIS & ENZYMOLOGY

PAPER CODE: BC334P **PPW: 3**
YEAR/SEMESTER: II/III **NO.OF CREDITS: 1**

COURSE OBJECTIVES

COb1 To understand the different quantitative methods for sugars.
COb2 To learn the steps in isolation, assay procedures and effect of physical factors on enzyme activity.

1. Estimation of reducing sugars by DNS method.
2. Estimation of total sugars by Anthrone method.
3. Estimation of Fructose by Roe's resorcinol method.
4. Analysis of Honey sample for total, reducing and non-reducing sugars.
5. Determination of achromic point of salivary α-amylase.
6. Assay of β-amylase from sweet potato.
7. Comparison of catalase activity in germinating seeds
8. Assay of acid and alkaline phosphatases from biological samples.
9. Determination of optimum temperature for amylase.
10. Determination of optimum pH for phosphatase.

REFERENCES:

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
2. Enzyme Assays- A practical Approach: Eisenthal, R and Dawson, M. I., IRL Press.
3. Biochemical Methods- Sadasivam, S and Manickam, A. New Age International Publishers.

COURSE OUTCOMES:

At the end of the course students will be able to:

BC334P.CO1 Implement the knowledge in carbohydrate analysis of various biological samples.
BC334P.CO2 Apply the assay methods to determine enzyme activity in various sources.

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(Academic year 2023-24)

COURSE NAME: BASICS IN BIOCHEMICAL CALCULATIONS AND BIOSTATISTICS

PAPER CODE: SE334 **PPW: 2**
YEAR/SEMESTER: II/III **NO.OF CREDITS: 2**

COURSE OBJECTIVE: To familiarize the students on the concept of biochemical calculations and biostatistics.

UNIT-WISE COURSE OBJECTIVES:

CObl To explain the principles in basic biochemical calculations.
COb2 To train the students in various biostatistical methods.

Unit I: Basic Biochemical Calculations **15 hrs**

1. Units and measurements
2. Concentration of analyte: Mole, Molarity, Normality and Percent solutions
3. Concept of density and specific gravity
4. Enzyme activity, Specific activity and purity index
5. pH scale and measurement of redox potential
6. Concept of buffers and Buffer preparations
7. Construction of calibration Curve and absorption curve (λ max)

Unit II: Biostatistics **15 hrs**

1. Basic statistical concepts: Population, sampling and variables
2. Biostatistics: Measures of central tendency (Mean, Median, Mode)
3. Measurement of dispersion: Standard deviation, standard error, Spread sheets
4. Depiction of data by graphical methods
5. t-Test
6. Regression and Correlation, precision and accuracy
7. ANOVA

References:

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
2. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern
3. Enzyme Assays- A practical Approach: Eisenthal, R and Dawson, M. I., IRL Press.
4. Biostatistics — Arora &Malhan, Himalaya Publishing House.

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COURSE OUTCOMES:

At the end of the course students will be able to:

SE334.CO1 Apply the biochemical calculations in project or research work.
SE334.CO2 Implement the various statistical methods to analyse and interpret the data statistically in research and pharma industries.

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Department of Biochemistry& Nutrition
(Academic year 2023-24)

PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: BIOCHEMICAL TECHNIQUES AND METABOLISM OF AMINO ACIDS AND NUCLEOTIDES

PAPER CODE: BC434 **PPW: 4**
YEAR/SEMESTER: II/IV **NO.OF CREDITS: 4**

COURSE OBJECTIVE: To illustrate the significance of metabolic pathways of amino acids and nucleotides and to discuss the principle, instrumentation and applications of various biochemical techniques.

UNIT-WISE COURSE OBJECTIVES:

COb1 To discuss the metabolism of amino acids and related genetic defects.
COb2 To explain the metabolic pathways of nucleotides in relation to genetic defects.
COb3 To discuss the principle and applications of centrifugation and chromatography techniques.
COb4 To explain the principle and applications of electrophoresis, photometric methods and radioisotopes.

Unit I: - Amino Acid Metabolism	**15hrs**
General reactions of amino acid metabolism- transamination, decarboxylation & deamination.	2hrs
Urea cycle and its regulation.	2hrs
Catabolism of carbon skeleton of amino acids- glycogenic and ketogenic amino acids.	2hrs
Metabolism of Glycine, Serine, Aspartic acid and Methionine.	2hrs
Metabolism of Phenylalanine and Leucine.	3hrs
Biosynthesis of creatine.	1hr
Nitrogen cycle - Biological nitrogen fixation.	2hrs
Inborn errors of aromatic and branched chain amino acid metabolism.	1hr

Unit II: - Nucleotide Metabolism	**15hrs**
Biosynthesis and regulation of purine nucleotides *(de novo* and Salvage pathways).	2hrs
Biosynthesis and regulation pyrimidine nucleotides (*de novo* and Salvage pathways).	2hrs
Allosteric regulation of Aspartate Transcarbamoylase (ATCase).	1hr
Catabolism of Purines and Pyrimidines.	3hrs
Biosynthesis of deoxyribonucleotides- Ribonucleotide reductase.	2hrs
Thymidylate synthase and its significance.	1hr
Disorders of nucleotide metabolism- Gout, Lesch- Nyhan syndrome.	1hr
Biosynthesis and degradation of Heme and Porphyrins.	3hrs

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Unit III: - Biochemical Techniques – I	**15hrs**
Methods of tissue homogenization (Potter-Elvejham, mechanical blender, sonicator& enzymatic).	1hr
Principle and applications of centrifugation techniques- differential, density gradient.	2hrs
Ultra-centrifugation- preparative and analytical.	3hrs
Principles and applications of – paper & thin layer chromatographic techniques.	1hr
Principle and applications of gel filtration chromatography.	2hrs
Principle and applications of ion- exchange chromatography.	2hrs
Principle and applications of affinity chromatography.	2hrs
Peptide sequencing and mapping.	2hrs

Unit IV: - Biochemical Techniques - II	**15 hrs**
Electrophoresis - principle and applications of paper, polyacrylamide (native and SDS).	2hrs
Principle and applications of agarose gel electrophoresis.	2hrs
Principle of Isoelectric focusing.	1hr
Colorimetry and Spectrophotometry – Laws of light absorption - Beer-Lambert's law, UV and visible absorption spectra, molar extinction coefficient.	3hrs
Biochemical applications of spectrophotometer.	3hrs
Principle of fluorimetry.	1hr
Tracer techniques: Radioisotopes, units of radio activity, half-life, β and γ- emitters.	1hr
Use of radioactive isotopes in biology. Principle of autoradiography.	2hrs

REFERENCES:

1. Principles and techniques of practical Biochemistry- Wilson, K and Walker, J. Cambridge Press.
2. The Tools of Biochemistry- Cooper, T.G. John Wiley & Sons Press.
3. Physical Biochemistry- Friefelder, D. W. H. Freeman Press.
4. Analytical Biochemistry- Holme. D.J. and Peck. H., Longman.
5. Biophysical Chemistry: Principles and Techniques –Upadhyay A., Upadhyay K and Nath. Himalaya Publishing House.
6. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W.H. Freeman

COURSE OUTCOMES:

At the end of the course students will be able to:

BC434.CO1 Relate the metabolic pathways of amino acids to various cellular functions.
BC434.CO2 Correlate metabolic pathways of nucleotides to various cellular functions.
BC434.CO3 Analyze and apply different techniques according to the sample and design the experiments in research projects.
BC434.CO4 Apply the analytical skills to research projects.

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PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: QUANTITATIVE ANALYSIS AND BIOCHEMICAL TECHNIQUES

PAPER CODE: BC434P **PPW: 3**
YEAR/SEMESTER: II/IV **NO.OF CREDITS: 1**

COURSE OBJECTIVES:

COb1 To understand the different quantitative methods for amino acids and proteins.
COb2 To learn different biochemical techniques for the separation of biomolecules.

1. Estimation of amino acid by ninhydrin method.
2. Estimation of protein by Biuret method.
3. Estimation of protein by Lowry's method.
4. Separation of plant pigments from various leaf and vegetable sources by TLC.
5. Separation of amino acids by paper electrophoresis.
6. Separation of proteins by SDS-PAGE and staining by Coomassie blue.
7. Separation of amino acids by paper chromatography.
8. Determination of ion exchange capacity of a resin by titrimetry.
9. Gel filtration chromatography.
10. Data analysis and construction of line, pie and bar graphs.

REFERENCES:

1. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
2. An Introduction to Practical Biochemistry-Plummer, D. T. Tata McGraw –Hill.
3. Introductory Practical Biochemistry (ed) Sawhney, S. K. Randhir Singh-Narosa Publications House.

COURSE OUTCOMES:

At the end of the course students will be able to:

BC434P.CO1 Quantify amino acids and proteins in different samples.
BC434P.CO2 Apply the relevant biochemical technique to analyse the sample for research purpose.

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COURSE NAME: CLINICAL LABORATORY DIAGNOSTICS

PAPER CODE: SE434 **PPW: 2**
YEAR/SEMESTER: II/IV **NO.OF CREDITS: 2**

COURSE OBJECTIVE: To familiarize students with theory and practical aspects of various clinical laboratory diagnostic tests of blood and urine.

UNIT-WISE COURSE OBJECTIVES:

COb1 To explain about clinical laboratory automation, methods of specimen collection and preservation.
COb2 To explain about biochemical tests associated with various organ functions.

Unit I Clinical Biochemistry **15 hrs**

1. Organization of clinical laboratory. Introduction to instrumentation and automation in clinical biochemistry laboratories, safety regulations and first aid.
2. General comments on specimen collection, types of specimen for biochemical analysis.
3. Precision, accuracy, quality control, precautions and limitations of specimen collection.
4. Basic physiology of hepatic, renal and cardiovascular systems.
5. Biochemical symptoms associated with hepatic and renal diseases and their diagnostic biochemical profile.
6. Clinical significance of variations in blood glucose. Diabetes mellitus.
7. Composition and functions of lipoproteins. Clinical significance of elevated lipoproteins.
8. Liver function tests.
9. Renal function tests and urine analysis.
10. Involvement of enzymes in diagnosis of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin.

Unit II: Practicals **15 hrs**

1. Collection of blood and storage.
2. Separation and storage of serum.
3. Estimation of blood glucose by glucose oxidase-peroxidase method.
4. Estimation of serum Triglycerides.
5. Estimation of bilirubin (direct and indirect).

6. Use of urine strip / dipstick method for urine analysis.
7. Quantitative determination of serum creatinine.
8. Quantitative determination of serum urea.
9. Estimation of creatine kinase MB.
10. Estimation of SGOT.

References:

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN:9780070076594 / ISBN:9780070076631
2. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. II (2010), Mukherjee, K.L., Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.
3. Medical Biochemistry (2005) 2nded., Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia), ISBN:0-7234-3341-0.
4. Experimental Biochemistry: A Student Companion (2005) Rao, B.S. and Deshpande, V., IK International Pvt. Ltd. (New Delhi), ISBN:81-88237-41-8.
5. Textbook of Medical Laboratory Technology: Godkar P.B. and Godkar D.p.2ndEdition, Bhalani publishing House
6. Textbook of Medical Physiology: Guyton A.C. and Hall J.E., Saunders publications

COURSE OUTCOMES:

At the end of the course students will be able to:

SE434.CO1 Apply the knowledge in collection and preservation of blood and urine samples in diagnostic labs.
SE434.CO2 Perform the diagnostic tests and analyze the results associated with various organ functions in health and disease.

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(Academic year 2024-25)

PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: PHYSIOLOGY AND CLINICAL BIOCHEMISTRY

PAPER CODE: BC534 **PPW: 4**
YEAR/SEMESTER: III/V **NO.OF CREDITS: 4**

COURSE OBJECTIVE: To familiarize the students with various endocrine glands and their secretions and to understand significance of clinical biochemistry in health and disease.

UNIT-WISE COURSE OBJECTIVES:

COb1 To understand the traditional practices of health and to explain the physiology of heart beat, muscle contraction, nervous system and vision.
COb2 To discuss the organization and functions of the endocrine system.
COb3 To discuss the relationship of clinical biochemistry in health and disease.
COb4 To explain the structure of organs and their function tests.

Unit I: -Traditional Indian systems of Health & Human Physiology **15hrs**

Folk and classical streams of medical knowledge in India, folk and tribal medicine, home remedies and primary health care. 1hr
āyurveda: Scope and variety of treatments in āyurveda. Eight clinical specialities of āyurveda.
Siddha: Pulse diagnosis, Varma treatment, Herbo-mineral formulations, concept of health and disease, preventive medicine. 1hr
Yoga: Health benefits of Āsanas, Prānāyāma and Meditation. Application of yoga as therapy in the modern world. 1hr
Digestion and absorption of carbohydrates, lipids and proteins. 2hrs
Composition of blood and coagulation of blood. 2hrs
Hemoglobin and transport of gases in blood (oxygen and CO_2). 1hr
Heart - structure of the heart, cardiac cycle, cardiac factors controlling blood pressure. 2hrs
Physiology of vision – pigments and visual cycle. 1hr
Muscle - kinds of muscles, structure of myofibril, organization of contractile proteins and mechanism of muscle contraction. 2hrs
Nervous system - structure of neuron, resting potential, action potential, propagation of nerve impulse, synapse, synaptic transmission, excitatory and inhibitory neurotransmitters. 2hrs

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Unit II: - Endocrinology **15 hrs**

Organization of endocrine system. Classification of hormones. 2hrs
Mechanism of hormonal action - signal transduction pathways for adrenaline, glucocorticoids and insulin. 2hrs
Outlines of chemistry, physiological role and disorders of pituitary and hypothalamic hormones. 3hrs
Outlines of chemistry, physiological role and disorders of pancreatic hormones. 2hrs
Outlines of chemistry, physiological role and disorders of thyroid and parathyroid hormones. 2hrs
Outlines of chemistry, physiological role and disorders of hormones of gonads and placenta. 1hr
Outlines of chemistry, physiological role and disorders of adrenal hormones. 2hrs
Introduction of gastrointestinal hormones. 1hr

Unit III: - Clinical Biochemistry **15hrs**

Plasma proteins in health and disease. 3hrs
Composition of blood and coagulation of blood. 3hrs
Disorders of blood coagulation (haemophilia). Types of anaemias, Haemoglobinopathies-sickle cell anaemia and thalassemia. 3hrs
Disorders of carbohydrate metabolism - hypoglycaemia, hyperglycaemia, glycosuria, renal threshold value. Diabetes mellitus - classification, glucose tolerance test (GTT), diabetic ketoacidosis. 3hrs
Disorders of lipid metabolism- plasma lipoproteins, lipoproteinemia, fatty liver hypercholesterolemia, atherosclerosis. 3hrs

Unit IV: Organs and Functional tests **15hrs**

Structure and functions of the liver. Liver diseases - jaundice, hepatitis, cirrhosis. 2hrs
Liver function tests- conjugated and total bilirubin in serum, albumin: globulin ratio, hippuric acid and bromosulphthalein tests. Serum enzymes in liver diseases- SGPT, GGT and alkaline phosphatase. 2hrs
Kidneys - structure of nephron, urine formation, normal and abnormal constituents of urine. 2hrs
Biological buffers. Role of kidneys in maintaining acid-base and electrolyte balance in the body. 2hrs
Renal function tests - creatinine and urea clearance tests, phenol red test. 1hr
Biochemical tests for the diagnosis of heart diseases - HDL/LDL cholesterol, SGOT, LDH, CK, C-reactive protein, cardiac troponins. 2hrs
Brain function tests- EEG 2hrs
GI tract test-Endoscopy 2hrs

REFERENCES:

1. Textbook of Biochemistry and Human Biology- Talwar, G.P. and Srivastava, L.M., Printice Hall of India.
2. Human Physiology- Chatterjee. C.C, Medical Allied Agency.
3. Textbook of Medical Physiology – Guyton. A.G and Hall. J.E., Saunders.
4. William's Textbook of Endocrinology- Larsen, R.P. Korenberg, H. N. Melmed, S, and Polensky, K.S. Saunders.
5. Mammalian Biochemistry – White, A. Handler, P. and Smith, E. L. McGraw – Hill.
6. Tietz Fundamentals of Clinical Chemistry- Burtis, A. A and Ashwood, E.R. Saunders- Imprint Elsevier Pub.
7. Textbook of Biochemistry with Clinical Correlations- Devlin. T.M., Wiley- Liss.

8. Mahadevan, B, Bhat Vinayak Rajat, Nagendra Pavana R. N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private LTD, Delhi.
9. Dharampal, *Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts*, Dharampal Classics Series, Rashtrotthana Sahitya, Bengaluru, 2021.
10. M. D. Srinivas, The methodology of Indian sciences as expounded in the disciplines of *Nyāya*, *Vyākarana*, *Ganita* and *Jyotisa*, in K. Gopinath and Shailaja D. Sharma (eds.), *The Computation Meme: Explorations in Indic Computational Thinking*, Indian Institute of Science, Bengaluru, 2022 (in press).
11. Bag, A. K (1997). History of Technology in India, Vol I, Indian National Science Academy, New Delhi. S

COURSE OUTCOMES:

At the end of the course students will be able to:

BC534.CO1 Implement traditional methods for a healthy life and well-being and relate physiology of heart beat, muscle contraction, nervous system and vision.
BC534.CO2 Compare the secretion and functions of various endocrine glands
BC534.CO3 Correlate the relationship of clinical biochemistry in health and disease.
BC534.CO4 To relate the structure of organs and the associated function tests.

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PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: PHYSIOLOGY AND CLINICAL BIOCHEMISTRY

PAPER CODE: BC534P **PPW: 2**
YEAR/SEMESTER: III/V **NO.OF CREDITS: 1**

COURSE OBJECTIVES

COb1 To learn and practice yoga.
COb2 To analyze various biochemical parameters in blood and urine samples.

1. Practical session on Yoga- Asanas and pranayama
2. Estimation of hemoglobin in blood. Total count - RBC and WBC. Differential count.
3. Urine analysis for abnormal constituents like albumin, sugars and ketone bodies.
4. Estimation of urinary creatinine.
5. Estimation of blood urea.
6. Estimation of serum total cholesterol.
7. Estimation of SGOT, SGPT
8. Determination of glycosylated hemoglobin.
9. Determination of blood glucose by POD/ GOD method.
10. Determination of serum lipid profile.

REFERENCES:

1. Practical Clinical Biochemistry- Varley, H. CBS Publishers.
2. Practical Clinical Biochemistry- Methods and Interpretations- Ranjna Chawla- Jaypee.
3. Manipal Manual of Clinical Biochemistry-Shivande Naik, B- Jaypee Brother medical Publications, New Delhi.
4. Laboratory manual in practical biochemistry- T. N Pattabhiraman
5. Lab manual in Biochemistry, Immunology and Biotechnology-Arti Nigam and Archana Ayyagari- Tata McGraw – Hill New Delhi.
6. Experimental Biochemistry: A Student Companion- Sashidhar Rao, B and Deshpande, V. IK International (P) LTD Pub.

COURSE OUTCOMES:

At the end of the course students will be able to:
BC534P.CO1 implement the knowledge of yoga in daily life.

BC534P.CO2 distinguish the different types of biological samples used and tests done for various biochemical investigations.

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PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: MICROBIOLOGY, GENETICS AND rDNA TECHNOLOGY

PAPER CODE: BC534A **PPW: 4**
YEAR/SEMESTER: III/V **NO.OF CREDITS: 4**

COURSE OBJECTIVE: To discuss the characteristic features of bacteria and viruses, to make understand basics of Mendelian and non-Mendelian inheritance and tools. techniques and applications of rDNA technology.

UNIT-WISE COURSE OBJECTIVES:

COb1 To describe the isolation, cultivation and identification of bacteria and viruses.
COb2 To discuss the concepts of Mendelian, Non-Mendelian inheritance.
COb3 To explain the tools and techniques in rDNA technology.
COb4 To discuss the principle of PCR, blotting methods and applications of rDNA technology.

Unit I: - Microbiology	**15 hrs**
Classification of microorganisms - prokaryotic and eukaryotic microorganisms.	1hr
Isolation and cultivation of bacteria. Selective and enriched media.	2hrs
Bacterial growth curve and kinetics of growth.	1hr
Batch, continuous and synchronous cultures.	2hrs
Gram's staining: Gram positive & Gram-negative bacteria, motility & sporulation.	2hrs
Structure and composition of viruses.	1hr
Isolation and cultivation of bacterial plaques.	2hrs
Lytic and lysogenic life cycle of λ phage.	2hrs
Life cycle of TMV and Retro virus (HIV).	2hrs

Unit II: - Genetics	**15 hrs**
Basic concepts of Mendelian inheritance (Mendel's work, Monohybrid & Dihybrid cross)	2hrs
Non-Mendelian inheritance: Extra chromosomal inheritance (paramecium).	2hr
Maternal inheritance (Coiling in snails).	1hr
Importance of meiosis in heredity.	1hr
Sex linked inheritance. X-linked recessive inheritance (color blindness).	2hrs
Polygenic inheritance (Introduction to quantitative traits).	2hr
Mutations: spontaneous/induced, forward/reverse, transition/transversion, Silent, missense, nonsense& Frame shift mutations.	3hrs
Mutagens- physical and chemical.	2hr

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Unit III: - Recombinant DNA technology-I **15hrs**

Outlines of cloning strategies. 1hr

DNA sequencing- Maxam Gilbert and Sanger's methods. 3hrs

Tools of r-DNA technology: Enzymes- Restriction endonucleases, ligase, phosphatases, reverse transcriptase, polynucleotide kinases, terminal transferase nucleases-S1 and RNase H. 3hrs

Restriction mapping. 1hr

Cloning vectors - Plasmids, Ti plasmids, Cosmids, λ phages, shuttle & expression vectors.3hrs

Host- *E. coli*, *Saccharomyces cerevisiae*, *Agrobacterium tumifaciens*. 2hrs

Construction of cDNA and genomic libraries. 2hrs

Unit IV: -Recombinant DNA technology-II **15 hrs**

Isolation and sequencing of cloned genes - colony hybridization, nucleic acid hybridization.2hrs

Hybrid released translation (HRT) and hybrid arrested and released translation (HART) using reporter genes [β- galactosidase, green fluorescent proteins (GFP). 3hrs

Polymerase chain reaction- Principle and applications. 2hr

Outlines of blotting techniques-Southern, Northern and Western. 2hrs

Applications of gene cloning- production of insulin and human growth hormone. 2hr

Production of Bt cotton and edible vaccines. 2hrs

Introduction to Bioinformatics- definitions of proteomics and genomics. Gene bank, NCBI, DDBJ, Swissprot, PDB. Sequence alignments- BLAST and FASTA. 2hrs

REFERENCES:

1. Microbiology- Prescott., Harley P & Klein. D. A, McGraw –Hill.
2. Microbiology- Pelczar Jr., M.J., Chan. E and Krieg. N. R, Tata McGraw-Hill.
3. Principles of Gene Manipulation- An Introduction to GE- Old, R.V. and Primrose, S. B. Blackwell Sci Pub.
4. Instant Notes –Bioinformatics-West head *et al*, ViVa Books (P) Ltd.
5. Introduction to Bioinformatics- Attwood T.K and Parry-Smith, D. J. Pearson Education.
6. Principles of Genetics- Snustad and Simmons.
7. Principles of Genetics- Anthony J.F. Griffiths, Jefferey H. Miller, David. T. Suzuki, Richard L. Lewontin, William. M. Gelbart. W.H. Freeman.
8. Concepts of Genetics- William S. Klug and Michael R. Cummings.

COURSE OUTCOMES:

At the end of the course students will be able to:

BC534A.CO1 Apply suitable methods in cultivation, identification and characterization of microorganisms.

BC534A.CO2 Relate the significance of heredity and variation and link with genetic diseases.

BC534A.CO3 Apply the basic knowledge of tools and techniques in gene cloning experiments.

BC534A.CO4 Implement the various rDNA methods in production of biotechnological products.

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PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: MICROBIOLOGY, GENETICS AND rDNA TECHNOLOGY

PAPER CODE: BC534AP | **PPW: 2**
YEAR/SEMESTER: III/V | **NO.OF CREDITS: 1**

COURSE OBJECTIVES

COb1 To outline the methods of sterilization, isolation, growth curve and morphology of bacterial cultures.
COb2 To explain the inheritance of traits using monohybrid and dihybrid crosses, proteins sequence alignment.

1. Preparation of culture media and sterilization methods.
2. Isolation of pure cultures: (i) Streak plate method. (ii) Serial dilution method
3. Gram staining.
4. Motility of bacteria by hanging drop method.
5. Bacterial growth curve.
6. Problems in monohybrid crosses.
7. Problems in dihybrid crosses.
8. Sequence alignments of insulin/BSA with other proteins using BLAST and FASTA.
9. Restriction Digestion- λ DNA with any two restriction enzymes.

REFERENCES:
1. Biotechnology: A Laboratory Project in Molecular Biology- Thiel, Bissen and Lyons. Tata McGraw- Hill.
2. Methods in Biotechnology-Hans-Peter Schmauder. Taylor & Francis.
3. Laboratory Experiments in Microbiology- Gopal Reddy, M. Reddy, M.N. Sai Gopal D. V.R and Mallaiah, K.V.
4. Practical Microbiology- Dubey, R.C and Maheshwari D.K.S Chand & Co.

COURSE OUTCOMES:
At the end of the course students will be able to:
BC534AP.CO1 isolate, categorize and identify specific bacteria by using appropriate bacterial culturing methods.
BC534AP.CO2 apply the knowledge of Mendel's laws to understand inheritance patterns, able to use BLAST and FASTA for protein sequence comparison in projects and research.

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COURSE NAME: BIOCHEMISTRY AND PHYSIOLOGY

PAPER CODE: GE534 | **PPW: 4**
YEAR/SEMESTER: III/V | **NO.OF CREDITS: 4**

COURSE OBJECTIVE: To familiarize students with various biomolecules, their metabolism and to understand physiology and significance of endocrine hormones.

UNIT-WISE COURSE OBJECTIVES:

COb1 To identify and learn various biomolecules.
COb2 To explain the significance of metabolism of biomolecules.
COb3 To explain the physiology of heart beat, muscle contraction, nervous system and vision.
COb4 To discuss the organization and functions of the endocrine system.

Unit-I: Biomolecules	**15hrs**
Water properties, pH and buffers.	2hrs
Carbohydrates-classification (mono, di, oligo and poly), properties and importance.	2hrs
Amino acids-classification, properties and importance. Structure of proteins.	2hrs
Lipids- classification, properties and importance.	2hrs
Nucleic acids-purines, pyrimidines, nucleosides, nucleotides. Structure and types of DNA and RNA and denaturation.	3hrs
Enzymes- classification, factors affecting enzyme activity, clinically important enzymes (SGOT, SGPT, LDH and CPK).	2hrs
Vitamins (fat soluble and water soluble) and Trace elements.	2hrs

Unit II: - Metabolism	**15hrs**
Inborn errors of amino acid metabolism.	1hr
Carbohydrate metabolism- glycolysis and TCA cycle.	2hrs
Gluconeogenesis and glycogen metabolism.	3hrs
Lipid metabolism-β-oxidation of fatty acids.	2hrs
Role of ketone bodies in health and disease.	2hrs
Disorders associated with nucleic acid metabolism.	1hr
Liver function tests (Bilirubin, GGT, SGPT)	1hr
Kidney function test (Serum Creatinine, Urea)	1hr

Obesity, hypertension and diabetes mellitus.	2hrs

Unit III: -Physiology	**15hrs**
Physiology of digestion.	2hrs
Physiology of vision.	2hrs
Physiology of muscle.	3hrs
Physiology of nerve and mechanism of nerve impulse transmission.	2hrs
Composition of blood and blood coagulation.	2hrs
Structure of heart and cardiac cycle.	2hrs
Factors controlling blood pressure.	2hrs

Unit IV: -Endocrinology	**15hrs**
Introduction to endocrinology and organization of endocrine system.	2hrs
Hormones of hypothalamus.	2hrs
Hormones of pituitary.	3hrs
Hormones of thyroid and clinical relevance.	2hrs
Hormones of pancreas and clinical relevance.	2hrs
Hormones of adrenal gland.	2hrs
Hormones of gonads.	2hrs

REFERENCES:

1. Lehninger, Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W.H. Freeman
2. Biochemistry, 4th Edition- Donald Voet, Judith G. Voet. - Publisher John Wiley & Sons.
3. Principles of Biochemistry: General Aspects- Smith, E. L., Hill, R.L. Lehman, I.R. Lefkowitz, R. J. Handler, P., and White, A. McGraw- Hill.
4. Textbook of Biochemistry and Human Biology- Talwar, G.P. and Srivastava. L.M., Printice Hall of India.

COURSE OUTCOMES:

At the end of the course students will be able to:

GE534.CO1 Differentiate the various biomolecules with respect to structure and function.
GE534.CO2 Correlate the metabolism of biomolecules and disorders associated with them.
GE534.CO3 Relate physiology of heart beat, muscle contraction, nervous system and vision.
GE534.CO4 Compare the secretion and functions of various endocrine glands

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(Academic year 2024-25)

PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: MOLECULAR BIOLOGY AND IMMUNOLOGY

PAPER CODE: BC634 **PPW: 4**
YEAR/SEMESTER: III/VI **NO.OF CREDITS: 4**

COURSE OBJECTIVE: To describe various events involved in replication, transcription, translation and regulation of gene expression and to familiarize the students with the significance of immune system and immunodiagnostics.

UNIT-WISE COURSE OBJECTIVES:
CObj1 To discuss the mechanism of DNA replication in prokaryotes.
CObj2 To understand the process of transcription, translation and regulation of gene expression.
CObj3 To discuss the components of the immune system and its functions.
CObj4 To explain the methods of immunodiagnostics and understand about vaccines.

Unit I: - DNA Replication	**15hrs**
Organization of genome in prokaryotes and eukaryotes.	2hrs
Nature and structure of the gene.	1hr
DNA replication- models of replication, Meselson-Stahl's experimental proof for semi-conservative model.	2hrs
Replication in Prokaryotes- DNA polymerases I, II and III of *E coli*.	2hrs
Helicase, topoisomerases, primase, ligase.	2hrs
Bidirectional replication model, Okazaki fragments.	1hr
Leading and lagging strand of DNA synthesis.	2hrs
Replication in Eukaryotes.	2hrs
Inhibitors of DNA replication.	1hr

Unit II: -Transcription and Translation	**15 hrs**
Transcription- RNA synthesis, RNA polymerases of prokaryotes and Eukaryotes.	2hrs
Promoters, Initiation, Elongation, Termination - rho dependent and rho independent.	2hrs
Transcriptional events in eukaryotic m-RNA synthesis.	1hr
Post-transcriptional modifications of eukaryotic m-RNA. Inhibitors of RNA synthesis	2hrs
Genetic code. Deciphering of genetic code. Nirenberg's and Khorana's experiments.	2hrs
Wobble hypothesis, degeneracy of genetic code.	1hr
Protein synthesis- Activation of amino acids (aminoacyl t-RNA synthetases). Ribosome structure.	1hr
Initiation, elongation and termination of protein synthesis. Post- translational modifications and Inhibitors of protein synthesis.	2hrs

Regulation of prokaryotic gene expression- Induction and repression. Lac operon.	2hrs

Unit III:- Immunology **15hrs**

Organization of immune system	1hr
Organs and cells of immune system.	1hr
Innate and acquired immunity.	2hrs
Cell mediated & humoral immunity	1hr
Activation of T& B - cells.	2hrs
Classification and structure of immunoglobulins. Structure of IgG.	2hrs
Epitopes / antigenic determinants. Concept of haptens. Adjuvants.	2hrs
Theories of antibody formation- clonal selection theory.	2hrs
Monoclonal antibodies and their applications.	2hrs

Unit IV: - Immunotechnology **15hrs**

Antigen-antibody reactions -Introduction, Agglutination, immunoprecipitation, immunodiffusion.	3hrs
Blood group antigens.	1hr
Immunodiagnostics-RIA, ELISA.	2hr
Vaccines and their classification.	1hr
Traditional vaccines-live and attenuated, toxoids.	1hr
Modern vaccines - recombinant and peptide vaccine.	1hr
Outlines of hypersensitivity reactions	2hrs
Autoimmune diseases.	1hr
Fundamentals of graft rejection and MHC proteins.	3hrs

REFERENCES:

1. Molecular biology- Freifelder. D. Naroasa Pub. House.
2. Genes VIII- Lewin. B, Oxford University Press.
3. Molecular Cell Biology- Lodish, H., Berk, A., Matsudaira, P., Kaiser, C.A., Krieger, M. Scott M.P., Zipursky, S.L. and Sarnell, Freeman & Co.
4. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W.H. Freeman
5. Molecular Biology of Cell- Alberts, B. Bray, D. Lewis, J. Raff, M. Roberts, K and Watson, J. D. Garland Publishing.
6. Biochemistry, 4th Edition- Donald Voet, Judith G. Voet. - Publisher John Wiley & Sons.
7. Immunology- Tizard, I. R. Thomson Press.
8. Kuby Immunology- Kindt. T.J., Goldsby. R.A and Osborne. B.A., Freeman & Co.
9. Roitt's Essential Immunology- Roitt. I.M and Delves. P. J., Blackwell Science.
10. Immune System- Parham., Garland Publishing.

COURSE OUTCOMES:

At the end of the course students will be able to:

BC634.CO1 Relate the importance of proteins involved in replication in maintaining its fidelity.
BC634.CO2 Correlate the significance of genetic material to the synthesis of normal proteins and also appreciate the adaptability of microorganisms to the changed environment.
BC634.CO3 Compare the basic mechanisms and functional interplay of innate and adaptive immunity.
BC634.CO4 Relate to the basic immunological principles involved in clinical and applied science.

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PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: MOLECULAR BIOLOGY AND IMMUNOLOGY

PAPER CODE: BC634P **PPW: 2**
YEAR/SEMESTER: III/VI **NO.OF CREDITS: 1**

COURSE OBJECTIVES

CObl To explain the isolation of DNA and check its purity, quantitative analysis of nucleic acids and demonstrate agarose gel electrophoresis.
COb2 To familiarize the students with various immunodiagnostic tests done in the clinical laboratories.

1. Isolation of DNA from onion/liver/coconut endosperm.
2. Determination of purity of nucleic acids by UV-Vis spectrophotometric method.
3. Estimation of DNA by diphenylamine method.
4. Estimation of RNA by orcinol method.
5. Estimation of DNA and RNA by Spectrophotometric method.
6. Agarose gel electrophoresis of DNA and visualization by methylene blue staining.
7. Determination of blood group and Rh typing.
8. Visualization of antigen antibody reactions by immune diffusion methods.
9. Determination of TSH by ELISA.
10. Determination of Ag-Ab specificity by Dot-blot method.

REFERENCES:

1. Experimental Biochemistry: A Student Companion-Shashidhar Rao, B and Deshpande, V. IK International (P) LTD Pub.
2. Biochemical Methods- Sadasivam, S and Manickam, A. New Age International Publishers.
3. An Introduction to Practical Biochemistry-Plummer, D. T. Tata McGraw –Hill.
4. Introductory Practical Biochemistry (ed) Sawhney, S. K. Randhir Singh-Narosa Publications House.
5. Laboratory Manual in Biochemistry- Jayaraman, J. Wiley Eastern.
6. Lab manual In Biochemistry, Immunology and Biotechnology-Arti Nigam and Archana Ayyagari- Tata McGraw – Hill New Delhi.

COURSE OUTCOMES:

At the end of the course students will be able to:

BC634P.CO1 apply the various isolation methods and compare and analyse nucleic acids quantitatively to work in molecular biology/diagnostic labs/ biotech labs or industry.
BC634P.CO2 use and interpret the results of different types of immunodiagnostic tests.

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(Academic year 2024-25)

PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: CELL BIOLOGY AND BIOTECHNOLOGY

PAPER CODE: BC634A **PPW: 4**
YEAR/SEMESTER: III/VI **NO.OF CREDITS: 4**

COURSE OBJECTIVE: To describe the structure, function, culturing and maintenance of cells and to introduce various bioinformatics tool for data analysis.

UNIT-WISE COURSE OBJECTIVES:

COb1 To discuss the structure and functions of sub cellular organelles.
COb2 To explain the various bioinformatics tools and different analysis methods.
COb3 To describe the different culture media, maintenance and characterize type of cell generated.
COb4 To understand the applications of biotechnology, drug designing and concept of nanotechnology.

Unit I: - Cell Biology	**15hrs**
Composition & functions of cell organelles.	3hrs
Cytoskeleton- Microfilaments, Microtubules & Intermediate filament.	
Extracellular matrix.	2hrs
Structure of chromosomes. Mitosis and meiosis.	2hrs
Cell cycle and cell death.	3hrs
Types of cancer, morphological changes of tissue and causative agents.	3hrs

Unit II: Bioinformatics	**15hrs**
Introduction to Bioinformatics.	2hrs
Biological databases.	3hrs
Concept of DNA and protein sequence alignment and their importance.	2hrs
Dot matrix analysis.	2hrs
Scoring schemes and substitution matrices.	2hrs
Principles of multiple alignments.	2hrs
Phylogenetic analysis.	2hrs

Unit III: Biotechnology-I	**15hrs**
Introduction to bioreactor.	1hr
Downstream processing.	2hrs
Animal cell culture methods, media, establishment and maintenance of cell culture.	2hrs
Characteristics of normal and transformed cell.	2hrs

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Stem cells and tissue regeneration. 2hrs
Plant cell cultures, callus culture and protoplast fusion. 3hrs
Biosensors -Principles and applications. 3hrs

Unit IV: Biotechnology-II **15hrs**
Bioremediation. 2hrs
Biogas and biofuel production. 2hrs
Production of high value therapeutics- Insulin and tissue plasminogen activator and interferons. 3hrs
Genetically modified plants and animals and their applications. 3hrs
Methods of Drug design and delivery. 3hrs
Introduction to Nano biotechnology& its applications. 2hrs

REFERENCES:

1. Molecular Biotechnology- Glick, B.R and Pasternak, J.J.ASM Press.
2. Principles of Gene Manipulation- An Introduction to GE- Old, R.V. and Primrose, S. B. Black well Sci Pub.
3. A Textbook of Biotechnology- Dubey, R.C.S Chand & Co.
4. Gene Biotechnology- Jogd and. Himalaya Pub House.
5. Instant Notes –Bioinformatics-Westhead *et al.*, ViVa Books (P) Ltd.
6. Introduction to Bioinformatics- Attwood T. K and Parry-Smith, D. J. Pearson Education.
7. Introduction to Bioinformatics- Lesk, A. M. Oxford University Press.
8. Cell Biology- Fundamentals and applications- Gupta and Jangir, Agrobio publishers.
9. Cell and Molecular Biology- E.O.P. De Robertis and E.M.F. De Robertis Jr, Lippincott Williams and Wilkins- VIIIth Edition.
10. Cell Biology- S.C. Rastogi, New age international publishers.

COURSE OUTCOMES:

At the end of the course students will be able to:

BC634A.CO1 Relate the structure and function of a normal to an abnormal cell.
BC634A.CO2 Retrieve, analyse and apply various bioinformatics tools in *in silico* studies.
BC634A.CO3 Apply the knowledge in culturing, maintenance of cell cultures in research.
BC634A.CO4 Apply the concept of transgenesis and drug designing in production of pharmacological products.

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PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: CELL BIOLOGY AND BIOTECHNOLOGY

PAPER CODE: BC634AP **PPW: 2**
YEAR/SEMESTER: III/VI **NO.OF CREDITS: 1**

COURSE OBJECTIVES

COb1 To explain about pure culturing methods and identification of bacteria by Gram staining and also to discuss karyotyping.

COb2 To familiarize the students about databases, pairwise and multiple sequence alignment with phylogenetic tree construction.

1. Preparation of culture media and sterilization methods.
2. Isolation of pure cultures: (i) Streak plate method. (ii) Serial dilution method
3. Gram staining.
4. Introduction to mitosis & study of mitotic chromosomes.
5. Introduction to meiosis & study of meiotic chromosomes.
6. Identification of Barr bodies from buccal cavity.
7. Karyotyping of Human chromosomes.
8. Bioinformatics- Types of Databases.
9. Pairwise alignment – BLAST and CLUSTAL-W
10. Phylogenetic tree construction.

REFERENCES:

1. Introductory Practical Biochemistry (ed) Sawhney, S. K. Randhir Singh-Narosa Publications House.
2. Experimental Biochemistry-A student companion-Beedu Sashidhar Rao and Vijay Deshpande.
3. An Introduction to Practical Biochemistry-Plummer, D.T. Tata McGraw –Hill.
4. Modern Genetic Analysis Anthony JF Griffiths, William M Gelbart, Jeffrey H Miller, and Richard C Lewontin. Pub. W. H. Freeman.
5. Principles of Genetics by Eldon John Gardner, Michael J. Simmons, D. Peter Snustad; John Wiley.

COURSE OUTCOMES:

At the end of the course students will be able to:

BC634AP.CO1 isolate and screen the microorganisms from various samples and analyze the position of chromosomes during cell division and karyotyping of human chromosomes helps them in genetics lab.

BC634AP.CO2 compare the sequences of different organisms to determine their evolutionary relationship using bioinformatics tools.

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(Academic year 2024-25)

PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

COURSE NAME: BIOCHEMISTRY IN HEALTH AND DISEASE

PAPER CODE: BC634_O **PPW: 4**
YEAR/SEMESTER: III/VI **NO.OF CREDITS: 4**

COURSE OBJECTIVES: To familiarize the students about the metabolic, genetic and the molecular basis of cancer.

UNIT-WISE COURSE OBJECTIVES:

COb1 To understand the metabolism of biomolecules and its related metabolic disorders.
COb2 To explain the causes, diagnosis and therapies about the abnormalities of genetic disorders.
COb3 To learn the collection and composition of various biological samples and their examination.
COb4 To understand the causative agents, genes, biomarkers, mechanism and therapies of cancer.

Unit I: - Metabolic disorders	**15hrs**
Amino acid metabolism	2hrs
Phenylketonuria, Alkaptonuria	2hrs
Carbohydrate metabolism	2hrs
Galactosemia, Pentosuria	2hrs
Nucleic acid metabolism	2hrs
Gout, Lesch Nyhan Syndrome	1hr
Lipid metabolism	2hrs
Gaucher's disease, Tay-Sach's disease	2hrs

Unit II: - Genetic disorders	**15hrs**
Introduction to genetic diseases	1hr
Chromosomal disorders – Down's syndrome, Turner syndrome	3hrs
Hemoglobinopathies, Sickle cell anaemia	2hrs
Thalassemia	2hrs
Genetic counselling	2hrs
Prenatal diagnosis	2hrs
Gene therapy	3hrs

Unit III: - Clinical Diagnosis	**15hrs**
Sample collection and preservation	2hrs
Examination of biological samples: blood, sputum and CSF	3hrs

Urine analysis: physical, chemical and microscopic	2hrs
Reference values and their establishment	2hrs
Clinical informatics	2hrs
Laboratory automation	2hrs
Quality assurance	2hrs

Unit IV: - Molecular basis of Cancer **15hrs**

Chemical carcinogens	2hrs
Fundamental features of carcinogenesis	2hrs
Oncogenes, Tumor suppressor genes causing cancer	2hrs
Tumor biomarkers in body fluids	2hrs
Mechanism of carcinogenesis	3hrs
New therapies in cancer	2hrs
Epigenetic mechanism in cancer	2hrs

REFERENCES:

1. Textbook of Biochemistry and Human Biology- Talwar, G.P. and Srivastava, L.M., Printice Hall of India.
2. Review of Medical Physiology- Ganong. McGraw – Hill.
3. Human Physiology- Chatterjee. C. C, Medical Allied Agency.
4. Textbook of Medical Physiology – Guyton. A.G and Hall. J.E., Saunders.
5. Tietz Fundamentals of Clinical Chemistry- Burtis, A.A and Ashwood, E.R. Saunders- Imprint Elsevier Pub.
6. Textbook of Biochemistry with Clinical Correlations- Devlin. T.M., Wiley- Liss.
7. Biochemistry, 4th Edition- Donald Voet, Judith G. Voet. - Publisher John Wiley & Sons.
8. Harper's illustrated Biochemistry

COURSE OUTCOMES:

At the end of the course students will be able to:

BC634_O.CO1 Analyze the underlying biochemical defect in various metabolic diseases.
BC634_O.CO2 Relate the chromosomal abnormalities with different genetic disorders.
BC634_O.CO3 Relate the various biological samples with respect to their examination and reference values.
BC634_O.CO4 Analyze and find possible therapies at molecular level to treat cancer.

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PROGRAM NAME: BCNDC (BIOCHEMISTRY, NUTRITION & DIETETICS, CHEMISTRY)

CHOICE BASED CREDIT SYSTEM (CBCS syllabus)

COURSE NAME: PROJECT WORK

PAPER CODE: BC634_PW **PPW: 4**
YEAR/SEMESTER: III/VI **NO.OF CREDITS: 4**

COURSE OBJECTIVES
COb1: To select a research topic and execute the planned work using correct methodology.
COb2: To organize the completed work in the form of project dissertation and submit.

1. Project work will involve experimental work/data collection and it has to be completed in the stipulated time by the student.
2. Students will be asked their choice for Project work at the beginning of Semester VI and all formalities of topic and mentor selection will be completed. Project work will be offered as per the expertise and infrastructural facilities available in the department.
3. Project work may be allotted to students as individual or as group project (not exceeding 5 students per group).
4. The completed work and compiled data would be presented in the form of results and submitted in the form of a dissertation/project report.
5. Final evaluation of the project work will be through a panel consisting of internal and external examiners.
6. Guidelines provided for execution and evaluation of project work would be strictly adhered.
7. The grading would be based on evaluation of punctuality, experimental work, record keeping, academic inputs, data presentation, interpretation etc.

Basic concepts of Project planning

a) Selection of Project topic and defining objectives

b) Planning of methods/approaches

Guidelines for Project writing

Title of the Project, Name of the Student & Supervisor

Declaration by the Student & Supervisor

Objectives of the project

Introduction & Review of Literature

Methodology

Results and Discussion

Conclusion

References

Course Outcomes

At the end of the course, students will be able to

BC634_PW.CO1: Plan and execute a project effectively in the stipulated time.
BC634_PW.CO2: develop analytical skills, statistical data handling skills, paper writing and oral presentation skills.

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